

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-271546

(43)Date of publication of application : 08.10.1999

---

(51)Int.Cl.

**G02B 6/122**

**G02B 6/42**

**H01L 31/0232**

**H01S 3/18**

**H04B 10/02**

**H04B 10/18**

---

(21)Application number : 10-072770

(71)Applicant : FUJITSU LTD

(22)Date of filing : 20.03.1998

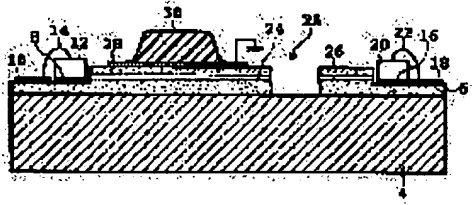
(72)Inventor : TERADA KOJI  
YAMAMOTO TAKESHI

---

(54) OPTICAL TRANSMISSION AND RECEPTION DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce crosstalk between a light emitting element and a photodetector mounted in a hybrid state on the same substrate by providing conductive resin applied over the substrate between the light emitting element and photodetector.



SOLUTION: On the substrate 4 of Si, etc., an insulating layer 6 is formed. On a conductor pattern 8 formed on the insulating layer 6, a laser diode 12 is mounted and on the conductor pattern 16, a laser diode 20 is mounted. In the insulating layer 6, optical waveguide cores 24 and 26 are embedded. One end of the optical waveguide core 24 is coupled with the laser diode 12 and the other end is connected to an output port. One end of the optical waveguide core 26 is optically coupled with the photodiode 20 and the other end is coupled with an input port. On the insulating layer 6, an electrode 28 is formed and further grounded. The electrode 28 is coated with

conductive resin 30 such as silver silicone, etc.

---

## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

\* NOTICES \*

**JPO and NCIP are not responsible for any damages caused by the use of this translation.**

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

## CLAIMS

---

### [Claim(s)]

[Claim 1] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern Conductive resin applied on said substrate between the 2nd wire to connect, the; aforementioned light emitting device, and said photo detector; the optical transceiver device characterized by providing the electrode of the potential regularity connected to said conductive resin, and;.

[Claim 2] The optical transceiver device according to claim 1 which possesses further the 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that an end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector.

[Claim 3] Said electrode is an optical transceiver device according to claim 2 grounded.

[Claim 4] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said light emitting device, the transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.

[Claim 5] Said electrode is an optical transceiver device according to claim 4 grounded.

[Claim 6] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said photo detector, the transparence insulation resin which covered the optical coupling section of this photo detector and said 2nd optical waveguide, and said a part of 3rd and 4th conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said

conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.

[Claim 7] Said electrode is an optical transceiver device according to claim 6 grounded.

[Claim 8] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [ the ] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said light emitting device, the transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.

[Claim 9] It is the optical transceiver device according to claim 8 to which said substrate is a conductive substrate, said electrode is directly formed on said conductive substrate, and said conductive resin and said conductive substrate are electrically connected through said electrode.

[Claim 10] Said conductive substrate is an optical transceiver device according to claim 9 grounded.

[Claim 11] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [ the ] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said photo detector, the transparence insulation resin which covered the optical coupling section of this photo detector and said 2nd optical waveguide, and said a part of 3rd and 4th conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.

[Claim 12] It is the optical transceiver device according to claim 11 by which said substrate is a conductive substrate, said electrode is directly formed on this conductive substrate, and said conductive resin is electrically connected to said conductive substrate through said electrode.

[Claim 13] Said conductive substrate is an optical transceiver device according to claim 12 grounded.

[Claim 14] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [ the ] And so that optical coupling of the light which spreads the 2nd optical waveguide may be carried out The 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port; so that the optical coupling section of said 1st, 2nd, and 3rd optical waveguides may be covered Transparence adhesives which fix said wavelength selection filter to said substrate, and conductive resin which covered the; aforementioned wavelength selection filter; the optical transceiver device characterized by providing the electrode of the potential regularity connected to said conductive resin, and;.

[Claim 15] It is the optical transceiver device according to claim 14 by which said substrate is a conductive substrate, said electrode is directly formed on said conductive substrate, and said conductive resin is electrically connected to said conductive substrate through said electrode.

[Claim 16] Said conductive substrate is an optical transceiver device according to claim 15 grounded.

[Claim 17] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [ the ] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said light emitting device, the 1st resin of transparence insulation which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and; -- the 2nd resin of conductivity which covered said 1st resin of transparence insulation, and; -- the potential connected to said 2nd resin of conductivity -- the 1st fixed electrode and; -- said photo detector -- The optical coupling section of this photo detector and said 2nd optical waveguide And said a part of 3rd and 4th conductor patterns the 3rd covered resin of transparence insulation, and; -- the 4th resin of conductivity which covered said 3rd resin of transparence insulation, and; -- the potential connected to said 4th resin of conductivity -- the 2nd fixed electrode and; -- so that the optical coupling section between said 1st, 2nd, and 3rd optical waveguides may be included Transparence adhesives which fix said applied wavelength

selection filter to said substrate, and the 5th resin of conductivity which covered the; aforementioned wavelength selection filter; the optical transceiver device characterized by providing the 3rd electrode of the potential regularity connected to said 5th resin of conductivity, and;.

[Claim 18] It is the optical transceiver device according to claim 17 by which said substrate is a conductive substrate, said 1st, 2nd, and 3rd electrodes are directly formed on said conductive substrate, and said 2nd conductive resin, the 4th conductive resin, and the 5th conductive resin are electrically connected to said conductive substrate through said 1st, 2nd, and 3rd electrodes, respectively.

[Claim 19] Said conductive substrate is an optical transceiver device according to claim 18 grounded.

\* NOTICES \*

**JPO and NCIP are not responsible for any damages caused by the use of this translation.**

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

## DETAILED DESCRIPTION

---

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical transceiver device which mounted the light emitting device and the photo detector on the same substrate.

[0002] In recent years, development of the optical device towards Guanghua of a subscriber system is furthered actively. Development of the bidirectional fiber to the user system using wavelength division multiplex techniques, such as STM-PON (synchronous transfer mode-passive optical network) and ATM-PON (asynchronous transfer mode-passive optical network), is furthered, and low-pricing of an optical device including a wavelength filter has been a very important technical problem.

[0003] In order to realize such a bidirectional fiber to the user system, a compact optical device with few components is required, and the device gestalt which carried out hybrid packaging of a light emitting device, a photo detector, the wavelength filter, etc. on one substrate is expected.

[0004] In the system by which the transmitting section and a receive section are asynchronous, and operate like ATM-PON, it is required for the crosstalk to a receive section from the transmitting section in an optical module to be small enough, and this invention offers the structure which controls crosstalk between transmission and reception in the optical transceiver device with which hybrid packaging of a light emitting device and the photo detector was carried out.

[0005]

[Description of the Prior Art] In recent years, the small optical transceiver device which carried out hybrid packaging of a light emitting device, a photo detector, and the wavelength selection filter on the substrate with waveguide called a planar light wave circuit platform (PLC platform) is developed.

[0006] However, this optical transceiver device has stopped at application in the time compression multiplexing (TCM) transmission system which carried out time sharing of air time and the time of delivery. The reason has

control of the cross talk from the transmitting section to a receive section in a difficult point.

[0007] Since a light emitting device is driven in the transmitting section, the small received current not more than  $\mu\text{A}$  order or it flows to several 10mA current flowing in a receive section. For this reason, it is called for that the currents which flow to a receive section by crosstalk from the transmitting section are 10nA order.

[0008]

[Problem(s) to be Solved by the Invention] Since the conventional PLC module is a small module with which the transmitting section and a receive section were accumulated on the same substrate, shielding is not formed between the transmitting section and a receive section. Therefore, it was difficult to realize crosstalk small enough for the stray capacity during transmit receive wiring etc.

[0009] In order to realize the miniaturization of the optical device for ATM-PON, while carrying out hybrid packaging of a light emitting device, a photo detector, and the wavelength selection filter on the same substrate, it is required to reduce crosstalk between transmit receives.

[0010] Therefore, the purpose of this invention is offering the optical transceiver device which can reduce crosstalk between the light emitting devices and photo detectors by which hybrid packaging's was carried out on the same substrate.

[0011]

[Means for Solving the Problem] According to this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern Conductive resin applied on said substrate between the 2nd wire to connect, the; aforementioned light emitting device, and said photo detector; the optical transceiver device characterized by providing the electrode of the potential regularity connected to said conductive resin and; is offered.

[0012] The 1st optical waveguide preferably formed so that an end might carry out optical coupling to a light emitting device, and the 2nd optical waveguide formed so that an end might carry out optical coupling to a photo detector are prepared. Preferably, the electrode is grounded.

[0013] According to other side faces of this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said light emitting device, Transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.

[0014] According to the side face of further others of this invention, it is an optical transceiver device. The

insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said photo detector, Transparence insulation resin which covered the optical coupling section of this photo detector and said 2nd optical waveguide, and said a part of 3rd and 4th conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.

[0015] According to the side face of further others of this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [ the ] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said light emitting device, Transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.

[0016] Preferably, a substrate is a conductive substrate and the electrode is directly formed on the substrate. Conductive resin is electrically connected to the conductive substrate through the electrode. Preferably, the conductive substrate is grounded.

[0017] According to the side face of further others of this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said



wavelength selection filter, and said wavelength selection filter; Said 1st [ the ] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said photo detector, Transparence insulation resin which covered the optical coupling section of this photo detector and said 3rd optical waveguide, and said a part of 3rd and 4th conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered. [0018]

[Embodiment of the Invention] Hereafter, many operation gestalten of this invention are explained with reference to a drawing. In explanation of each operation gestalt, the same sign is substantially attached and explained about the same component.

[0019] Reference of drawing 1 shows the sectional view of optical transceiver device 2A of the 1st operation gestalt of this invention. The insulating layer 6 is formed on the substrates 4, such as Si substrate. the case where a substrate 4 is formed from silicon -- an insulating layer 6 -- SiO<sub>2</sub> from -- it is formed.

[0020] The conductor patterns 8 and 10 of a pair are formed in the left-hand side of an insulating layer 6, and the conductor patterns 16 and 18 of other pairs are formed in right-hand side. The laser diode 12 is mounted on the conductor pattern 8, and bonding connection of a laser diode 12 and the conductor pattern 10 is made with the golden wire 14. The photodiode 20 is mounted on the conductor pattern 16, and bonding connection of a photodiode 20 and the conductor pattern 18 is made with the golden wire 22.

[0021] Into the insulating layer 6, two optical waveguide cores 24 and 26 are laid underground. The end of the optical waveguide core 24 is arranged so that optical coupling may be carried out to a laser diode 12, and the other end is connected to the output port which is not illustrated. The end of the optical waveguide core 26 is arranged so that optical coupling may be carried out to a photodiode 20, and the other end is connected to the input port which is not illustrated.

[0022] The electrode 28 is formed on the insulating layer 6, and the electrode 28 is grounded. Conductive resin 30, such as silver silicone, is applied on the electrode 28. instead of grounding an electrode 28 -- for example, the potential of 3V and 5V grade -- you may make it connect with a fixed power source

[0023] According to this operation gestalt, since conductive resin 30 is formed between the laser diode 12 and the photodiode 20, crosstalk between a laser diode 12 and a photodiode 20 can be reduced.

[0024] Reference of drawing 2 shows the sectional view of optical transceiver device 2B of the 2nd operation gestalt of this invention. With this operation gestalt, transparence insulation resin 32, such as silicone resin, is applied to the perimeter of a laser diode 12.

[0025] Transparence insulation resin 32 has covered some of optical coupling sections of a laser diode 12 and the optical waveguide core 24, wires 14, and conductor patterns 8 and 10. This transparence insulation resin 32 has the role which prevents the short circuit of the conductor patterns 8 and 10 by the conductive resin applied later while securing the optical path to the optical waveguide core 24.

[0026] Conductive resin 34, such as silver silicone, is applied on transparence insulation resin 32. Conductive resin 34 is connected to the grounded electrode 36. Instead of grounding an electrode 36, you may make it connect with the power source of potential regularity.

[0027] According to this operation gestalt, since the laser diode 12 is covered with transparence insulation resin 32 and conductive resin 34, the crosstalk to other passive circuit elements of photodiode 20 grade from a laser diode 12 can be reduced.

[0028] Reference of drawing 3 shows the sectional view of optical transceiver device 2C of the 3rd operation gestalt of this invention. With this operation gestalt, transparence insulation resin 38, such as silicone resin, is applied to the perimeter of a photodiode 20. Transparence insulation resin 38 has covered some of optical coupling sections of a photodiode 20 and the optical waveguide core 26, wires 22, and conductor patterns 16 and 18.

[0029] Conductive resin 40, such as silver silicone, is applied on transparence insulation resin 38. Conductive resin 40 is connected to the grounded electrode 42. Instead of grounding an electrode 42, you may make it connect with the power source of potential regularity.

[0030] Transparence insulation resin 38 has the role which prevents the short circuit of the conductor patterns 16 and 18 by the applied conductive resin 40 while securing the optical path from the waveguide core 26 to a photodiode 20.

[0031] According to this operation gestalt, the effectiveness which it not only can intercept effectively the crosstalk to a photodiode 20 from a laser diode 12, but intercepts external noises, such as IC for a drive prepared outside, is expectable.

[0032] Reference of drawing 4 shows the sectional view of optical transceiver device 2D of the 4th operation gestalt of this invention. Drawing 5 shows the top view of the 4th operation gestalt. With this operation gestalt, while the perimeter of a laser diode 12 is covered by transparence insulation resin 32, such as silicone resin, transparence insulation resin 32 is covered with conductive resin 34, such as silver silicone.

[0033] Moreover, the perimeter of a photodiode 20 is also covered by transparence insulation resin 38, such as silicone resin, and transparence insulation resin 38 is covered with conductive resin 40, such as silver silicone.

[0034] Furthermore, in this operation gestalt, the slot 46 is formed in the Si substrate 4, the wavelength selection filter 48 is inserted all over this slot 46, and it is fixed with the transparence adhesives 50. As shown in drawing 5, on the Si substrate 4, the 2nd optical waveguide core 56 which carries out optical coupling of the 1st optical waveguide core 54 which carries out optical coupling of a laser diode 12 and the wavelength selection filter 48, and a photodiode 20 and the wavelength selection filter 48 is formed.

[0035] The 3rd optical waveguide core 58 is formed between the wavelength selection filter 48 and optical input/output port 59 so that optical coupling of the light which spreads the 1st and 2nd optical waveguide cores 54 and 56 may be further carried out on the Si substrate 4.

[0036] The perimeter of the wavelength selection filter 48 is covered with conductive resin 52, such as silver silicone. On the Si substrate 4, the substrate contact electrodes 64, 66, 68, and 70 are formed directly.

[0037] The rear-face electrode 72 is formed in the rear face of the Si substrate 4. The rear-face electrode 72 is grounded. Instead of grounding the rear-face electrode 72, you may make it connect with the power source of potential regularity.

[0038] Since the Si substrate 4 is conductivity, conductive resin 34 is grounded through the substrate contact electrode 64, the Si substrate 4, and the rear-face electrode 72. Similarly, conductive resin 40 is grounded through the substrate contact electrode 66, the Si substrate 4, and the rear-face electrode 72. Furthermore, conductive resin 52 is grounded through the substrate contact electrodes 68 and 70, the Si substrate 4, and the rear-face electrode 72.

[0039] According to this operation gestalt, a laser diode 12 is covered with conductive resin 34 through transparence insulation resin 32, and the photodiode 20 is covered with conductive resin 40 through transparence insulation resin 38. Furthermore, conductive resin 52 is formed between the laser diode 12 and the photodiode 20.

[0040] Therefore, while being able to intercept thru/or reduce effectively crosstalk between a laser diode 12 and a photodiode 20, external noises, such as IC for a drive prepared outside, can also be intercepted or reduced effectively. Consequently, implementation of the optical transceiver device which can be operated [ that it is small and ] asynchronously is possible.

[0041] Hereafter, with reference to a drawing, the manufacture process of optical transceiver device 2D of the 4th operation gestalt is explained. First, as shown in drawing 6 (A), it is SiO<sub>2</sub> [ with a thickness of about 1 micrometer ] on the Si (100) substrate 74. The film 76 is formed by thermal oxidation etc.

[0042] Subsequently, SiO<sub>2</sub> other than the field which carries out patterning by the photolithography and forms a terrace 78 The film (oxide film) 76 is removed. It dips in a KOH solution and is SiO<sub>2</sub>. The field which removed the film 76 is etched. The depth of this etching is made into thickness about extent of the undershirt clad of waveguide, i.e., about 20 micrometers.

[0043] Subsequently, SiO<sub>2</sub> from which only the depth etched by the flame depositing method etc. serves as the 1st undershirt clad 80 as shown in drawing 6 (B) It deposits all over a substrate. Subsequently, flattening is ground and carried out until the top face of a terrace 78 is exposed, as shown in drawing 6 (C).

[0044] SiO<sub>2</sub> which serves as the 2nd undershirt clad 82 as shown in drawing 7 (D) Only the thickness called for by the bottom formula is deposited all over a substrate 74.

Deposition thickness =(conductor pattern thickness) +(pewter thickness)+ (barrier layer height of a laser diode) This deposition thickness is about 20 micrometers. Subsequently, the core layer 84 which doped the impurity to which the refractive index of germanium (germanium) etc. is made to increase is deposited, patterning of the unnecessary fields other than the guided wave section is carried out by the photolithography, they are removed, and a waveguide core is formed. Subsequently, the thickness SiO<sub>2</sub> comparable as the undershirt clads 80 and 82 is deposited all over a substrate, and the exaggerated clad 86 is formed.

[0045] Subsequently, as shown in drawing 7 (E), the field containing the light corpuscle child loading section and the conductor pattern formation section is etched by reactive ion etching (RIE), and the waveguide end faces 90 and 92 are formed. The depth to etch is carried out until the top face of a terrace 78 is exposed exactly.

[0046] Similarly, it etches by RIE, holes 91, 93, 95, and 97 are formed, and the Si substrate 74 and the substrate contact electrodes 64, 66, 68, and 70 which take a flow are formed all over these holes. 88 is a resist.

[0047] Subsequently, as shown in drawing 8 and drawing 9 , it is about 0.5-micrometer thin SiO<sub>2</sub> on a terrace 78 by thermal oxidation. An insulator layer 6 is formed. Furthermore, the slot 94 which crosses the point that the waveguide cores 54, 56, and 58 join using a dicing saw is formed.

[0048] Subsequently, the sequential vacuum evaporation of Ti, nickel, and the Au is carried out all over a substrate, and a resist is applied further. It etches by leaving the part of conductor patterns 6, 8, 16, and 18, and a photolithography technique removing a resist.

[0049] Etching may be performed by RIE and a substrate may be dipped in etchant. The etchant of a nitric-acid system is used to Ti and nickel, and golden etchant is used for Au. As an alternative, it is possible to also form conductor patterns 6, 8, 16, and 18 by the lift-off method. Similarly, the rear-face electrode 72 is formed in the rear face of a substrate 74.

[0050] Subsequently, polyimide resin is applied to the whole substrate top face by the spinner, and a resist is applied further. Patterning of the resist is carried out with a photolithography technique, and it is further immersed in a solvent, and polyimide resin is removed so that the light corpuscle child loading section, the pad section for wirebonding, and a waveguide end face may be exposed at least.

[0051] this shows drawing 10 -- as -- a conductor -- a part of patterning 8 and 10 covers by the polyimide

insulating layer 96 -- having -- a conductor -- a part of patterning 16 and 18 is covered by the polyimide insulating layer 98. Subsequently, a dicing saw cuts the Si substrate 74 to each PLC platform.

[0052] Subsequently, as shown in drawing 11 , a laser diode 12 and a photodiode 20 are mounted in a position by bonding. this bonding -- the light corpuscle child 12 side and 20 sides -- a pewter bump -- forming -- you may carry out -- a PLC platform side -- pewter bump \*\*\*\*\* -- it is good even if like.

[0053] Bonding connection of a laser diode 12 and the conductor pattern 10 is made with the golden wire 14 after mounting of a laser diode 12 and a photodiode 20, and bonding connection of a photodiode 20 and the conductor pattern 18 is made with the golden wire 22. Furthermore, the wavelength selection filter 48 is inserted all over a slot 94, and the wavelength selection filter 48 is fixed to the PLC platform (substrate) 4 with the transparent adhesives 50.

[0054] Subsequently, as shown in drawing 4 and drawing 5 , potting of the transparence insulation resin 32 and 38, such as silicone resin, is carried out to the perimeter of a laser diode 12 and a photodiode 20, and it carries out a cure to it.

[0055] Silicone resin with the high viscosity which mixed fillers, such as a silica, in the perimeter of a laser diode 12 and a photodiode 20 depending on the need is applied in the shape of a dam, transparent silicone resin flows, and it is good also as a stop.

[0056] Furthermore, the outside of transparence insulation resin 32 and 38 and the perimeter of the wavelength selection filter 48 are covered with conductive resin 34, 40, and 52, such as silver silicone resin. It is made for conductive resin 34, 40, and 52 to contact the substrate contact electrodes 64, 66, 68, and 70 at this time. The cure of the conductive resin 34, 40, and 52 is carried out to the last.

[0057] Thus, optical transceiver device 2D of the formed 4th operation gestalt is shown in drawing 4 and drawing 5 . Furthermore, although not illustrated especially, packaging of the optical transceiver device 2D is carried out by plastics mold etc.

[0058]

[Effect of the Invention] As explained above, according to this invention, the optical transceiver device which can reduce crosstalk between the light emitting device by which hybrid packaging was carried out on the same substrate, and a photo detector can be offered. Furthermore, offer of a compact and the optical transceiver device which can be operated asynchronously is attained, and it can contribute to the spread of optical subscriber systems.

\* NOTICES \*

**JPO and NCIP are not responsible for any damages caused by the use of this translation.**

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

## DESCRIPTION OF DRAWINGS

---

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view of the 1st operation gestalt of this invention.

[Drawing 2] It is the sectional view of the 2nd operation gestalt of this invention.

[Drawing 3] It is the sectional view of the 3rd operation gestalt of this invention.

[Drawing 4] It is the sectional view of the 4th operation gestalt of this invention.

[Drawing 5] It is the top view of the 4th operation gestalt.

[Drawing 6] It is drawing showing a manufacture process.

[Drawing 7] It is drawing showing a manufacture process.

[Drawing 8] It is drawing showing a manufacture process.

[Drawing 9] It is drawing showing a manufacture process.

[Drawing 10] It is drawing showing a manufacture process.

[Drawing 11] It is drawing showing a manufacture process.

[Description of Notations]

4 Substrate

8, 10, 16, 18 Conductor pattern

12 Light Emitting Device

20 Photo Detector

24 26 Optical waveguide

28, 36, 42 Electrode

30, 34, 40, 52 Conductive resin

32 38 Transparence insulation resin

64, 66, 68, 70 Substrate contact electrode

\* NOTICES \*

**JPO and NCIP are not responsible for any  
damages caused by the use of this translation.**

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

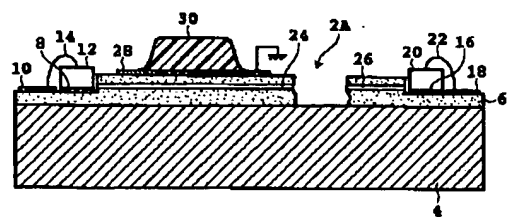
---

DRAWINGS

---

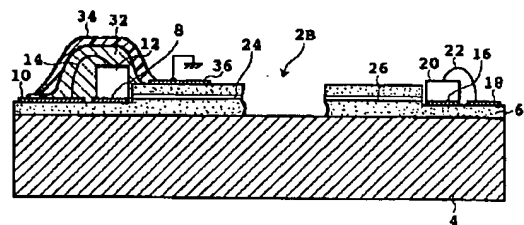
[Drawing 1]

第1実施形態



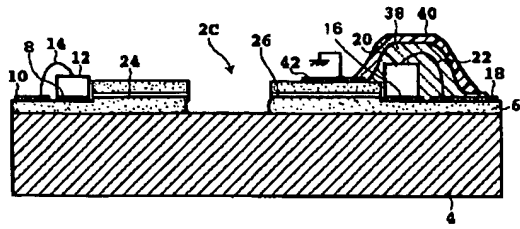
[Drawing 2]

第2実施形態



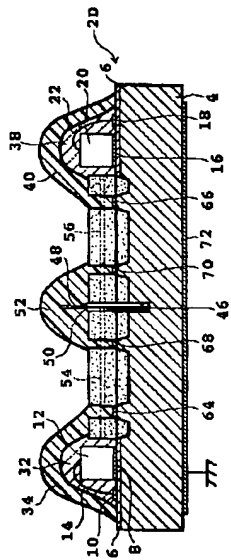
[Drawing 3]

### 第3実施形態



[Drawing 4]

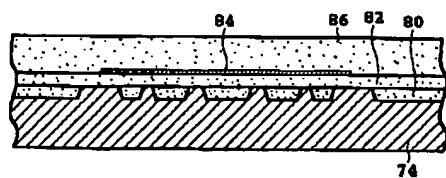
### 第4実施形態



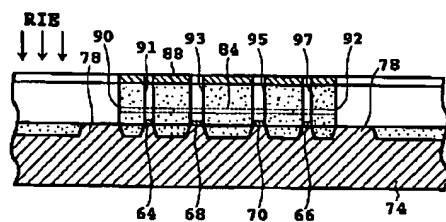
[Drawing 7]

製造プロセス図

(D)

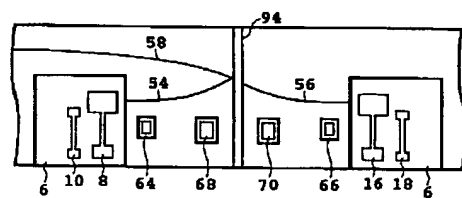


(E)



[Drawing 8]

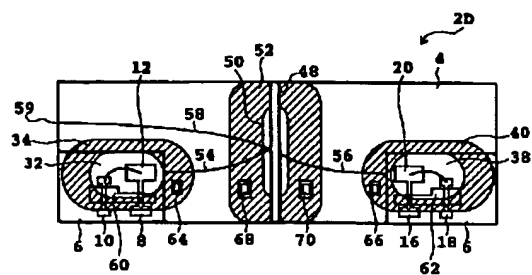
製造プロセス図



[Drawing 5]

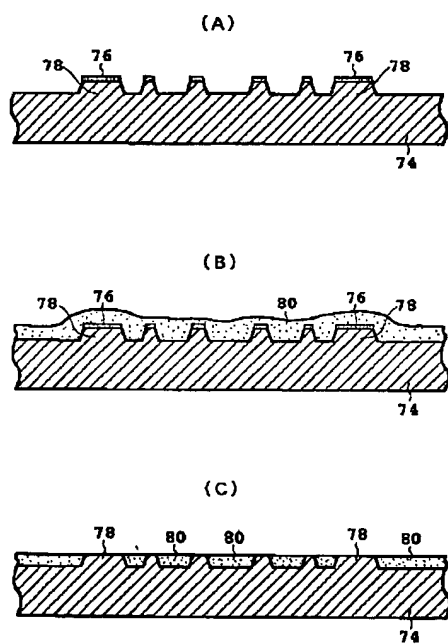


第4実施形態平面図



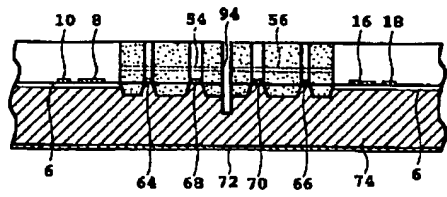
[Drawing 6]

製造プロセス図



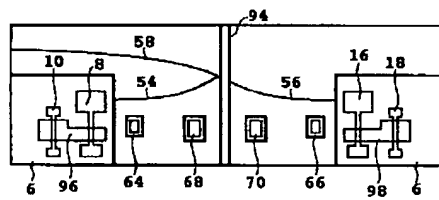
[Drawing 9]

製造プロセス図



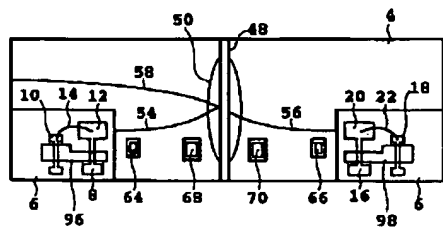
[Drawing 10]

製造プロセス図



[Drawing 11]

製造プロセス図



(19)日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11)特許出願公開番号

特開平11-271546

(43)公開日 平成11年(1999)10月8日

(51)Int.Cl. <sup>6</sup>	識別記号	F I	
G 0 2 B 6/122		C 0 2 B 6/12	B
6/42		6/42	
H 0 1 L 31/0232		H 0 1 S 3/18	
H 0 1 S 3/18		H 0 1 L 31/02	C
H 0 4 B 10/02		H 0 4 B 9/00	M
審査請求 未請求 請求項の数19 O L (全 10 頁) 最終頁に続く			

(21)出願番号 特願平10-72770

(22)出願日 平成10年(1998)3月20日

(71)出願人 000003223

富士通株式会社

神奈川県川崎市中原区上小田中4丁目1番  
1号

(72)発明者 寺田 浩二

神奈川県川崎市中原区上小田中4丁目1番  
1号 富士通株式会社内

(72)発明者 山本 毅

神奈川県川崎市中原区上小田中4丁目1番  
1号 富士通株式会社内

(74)代理人 弁理士 松本 昂

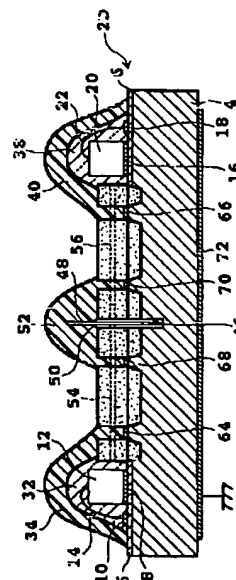
(54)【発明の名称】 光送受信デバイス

(57)【要約】

【課題】 本発明の課題は、同一基板上にハイブリッド実装された発光素子と受光素子の間の漏話を低減可能な光送受信デバイスを提供することである。

【解決手段】 光送受信デバイスであって、基板上に発光素子と受光素子がハイブリッド実装されている。発光素子と受光素子の間の基板には導電性樹脂が塗布されており、この導電性樹脂は電位一定の電極に接続されている。発光素子と受光素子の間に導電性樹脂を設けたことにより、発光素子と受光素子の間の漏話を低減することができる。この構成に代えて、発光素子又は受光素子を導電性樹脂で覆うようにしてもよい。この場合には、発光素子と光導波路との光結合部及び受光素子と光導波路との光結合部をまず透明絶縁性樹脂で覆ってから、その上に導電性樹脂を適用する。

第4実施形態



## 【特許請求の範囲】

【請求項1】 光送受信デバイスであって、  
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記発光素子と前記受光素子の間の前記基板上に塗布された導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項2】 一端が前記発光素子に光結合するように前記基板上に形成された第1光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第2光導波路とを更に具備した請求項1記載の光送受信デバイス。

【請求項3】 前記電極は接地されている請求項2記載の光送受信デバイス。

【請求項4】 光送受信デバイスであって、  
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第1光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第2光導波路と；前記発光素子、該発光素子と前記第1光導波路の光結合部及び前記第1及び第2導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項5】 前記電極は接地されている請求項4記載の光送受信デバイス。

【請求項6】 光送受信デバイスであって、  
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第1光導波路と；一端が前記受光素子に光結合するように前記基板上

に形成された第2光導波路と；前記受光素子、該受光素子と前記第2光導波路の光結合部及び前記第3及び第4導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項7】 前記電極は接地されている請求項6記載の光送受信デバイス。

【請求項8】 光送受信デバイスであって、  
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第1光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第2光導波路と；前記第1及び第2光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第3光導波路と；前記発光素子、該発光素子と前記第1光導波路の光結合部及び前記第1及び第2導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項9】 前記基板は導電性基板であり、前記電極は前記導電性基板上に直接形成されており、前記導電性樹脂と前記導電性基板とは前記電極を介して電気的に接続されている請求項8記載の光送受信デバイス。

【請求項10】 前記導電性基板は接地されている請求項9記載の光送受信デバイス。

【請求項11】 光送受信デバイスであって、  
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第1光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第2光導波路と；前記第1及び第2光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの

間の前記基板上に形成された第3光導波路と；前記受光素子、該受光素子と前記第2光導波路の光結合部及び前記第3及び第4導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項12】 前記基板は導電性基板であり、前記電極は該導電性基板上に直接形成されており、前記導電性樹脂は前記電極を介して前記導電性基板に電気的に接続されている請求項1記載の光送受信デバイス。

【請求項13】 前記導電性基板は接地されている請求項1記載の光送受信デバイス。

【請求項14】 光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第1光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第2光導波路と；前記第1及び第2光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第3光導波路と；前記第1、第2及び第3光導波路の光結合部を覆うように前記波長選択フィルタを前記基板に固定する透明接着剤と；前記波長選択フィルタを覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項15】 前記基板は導電性基板であり、前記電極は前記導電性基板上に直接形成されており、前記導電性樹脂は前記電極を介して前記導電性基板に電気的に接続されている請求項14記載の光送受信デバイス。

【請求項16】 前記導電性基板は接地されている請求項15記載の光送受信デバイス。

【請求項17】 光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された

第1光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第2光導波路と；前記第1及び第2光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第3光導波路と；前記発光素子、該発光素子と前記第1光導波路の光結合部及び前記第1及び第2導体パターンの一部を覆った透明絶縁性第1樹脂と；前記透明絶縁性第1樹脂を覆った導電性第2樹脂と；前記導電性第2樹脂に接続された電位一定の第1電極と；前記受光素子、該受光素子と前記第2光導波路の光結合部及び前記第3及び第4導体パターンの一部を覆った透明絶縁性第3樹脂と；前記透明絶縁性第3樹脂を覆った導電性第4樹脂と；前記導電性第4樹脂に接続された電位一定の第2電極と；前記第1、第2及び第3光導波路間の光結合部を含むように適用された前記波長選択フィルタを前記基板に固定する透明接着剤と；前記波長選択フィルタを覆った導電性第5樹脂と；前記導電性第5樹脂に接続された電位一定の第3電極と；を具備したことを特徴とする光送受信デバイス。

【請求項18】 前記基板は導電性基板であり、前記第1、第2及び第3電極は前記導電性基板上に直接形成されており、前記第2導電性樹脂、第4導電性樹脂及び第5導電性樹脂はそれぞれ前記第1、第2及び第3電極を介して前記導電性基板に電気的に接続されている請求項17記載の光送受信デバイス。

【請求項19】 前記導電性基板は接地されている請求項18記載の光送受信デバイス。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は同一基板上に発光素子と受光素子とを実装した光送受信デバイスに関する。

【0002】近年、加入者系の光化に向けた光デバイスの開発が活発に進められている。STM-PON（シンクロナス・トランスファー・モード・パッシブ・オプティカル・ネットワーク）及びATM-PON（アシンクロナス・トランスファー・モード・パッシブ・オプティカル・ネットワーク）などの波長分割多重技術を用いた双方向光加入者系システムの開発が進められており、波長フィルタを含めた光デバイスの低価格化が極めて重要な課題となっている。

【0003】このような双方向光加入者系システムを実現するためには、部品数の少ないコンパクトな光デバイスが必要であり、発光素子、受光素子及び波長フィルタ等を1つの基板上にハイブリッド実装したデバイス形態が期待されている。

【0004】ATM-PONのように送信部と受信部が非同期で動作するシステムでは、光モジュール内の送信部から受信部への漏話が十分小さいことが必要であり、本発明は発光素子及び受光素子がハイブリッド実装された光送受信デバイスにおいて、送信及び受信間の漏話を

抑制する構造を提供するものである。

【0005】

【従来の技術】近年、プレーナ・ライトウェイブ・サーキット・プラットフォーム（PLCプラットフォーム）と呼ばれる導波路付基板上に発光素子、受光素子及び波長選択フィルタをハイブリッド実装した小型の光送受信デバイスが開発されている。

【0006】しかし、この光送受信デバイスは送信時間と受信時間とを時分割したタイム・コンプレッション・マルチプレキシング（TCM）伝送系への適用に止まっている。その理由は、送信部から受信部へのクロストークの抑制が困難な点にある。

【0007】送信部では発光素子を駆動するために数10mAの電流が流れるのに対し、受信部では $\mu$ Aオーダーかそれ以下の小さな受信電流が流れる。このため、送信部からの漏話によって受信部に流れる電流は10nAオーダーであることが求められる。

【0008】

【発明が解決しようとする課題】従来のPLCモジュールは同一基板上に送信部及び受信部が集積された小型なモジュールであるため、送信部と受信部の間にシールドが形成されていない。故に、送信受信配線間の浮遊容量等のために十分に小さな漏話を実現することが困難であった。

【0009】ATM-PON向けの光デバイスの小型化を実現するためには、発光素子、受光素子及び波長選択フィルタを同一基板上にハイブリッド実装すると共に、送信受信間の漏話を低減することが必要である。

【0010】よって、本発明の目的は、同一基板上にハイブリッド実装された発光素子と受光素子の間の漏話を低減することが可能な光送受信デバイスを提供することである。

【0011】

【課題を解決するための手段】本発明によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記発光素子と前記受光素子の間の前記基板上に塗布された導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【0012】好ましくは、一端が発光素子に光結合するように形成された第1光導波路と、一端が受光素子に光結合するように形成された第2光導波路が設けられている。好ましくは、電極は接地されている。

【0013】本発明の他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第1光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第2光導波路と；前記発光素子、該発光素子と前記第1光導波路の光結合部及び前記第1及び第2導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【0014】本発明の更に他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第1光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第2光導波路と；前記受光素子、該受光素子と前記第2光導波路の光結合部及び前記第3及び第4導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【0015】本発明の更に他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第1光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第2光導波路と；前記第1及び第2光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第3光導

波路と；前記発光素子、該発光素子と前記第1光導波路の光結合部及び前記第1及び第2導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【0016】好ましくは、基板は導電性基板であり、基板上に電極が直接形成されている。導電性樹脂は電極を介して導電性基板に電気的に接続されている。好ましくは、導電性基板は接地されている。

【0017】本発明の更に他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第1及び第2導体パターンと；前記絶縁層上に互いに隣接して形成された第3及び第4導体パターンと；前記第1導体パターン上に実装された発光素子と；前記発光素子と前記第2導体パターンを接続する第1ワイヤと；前記第3導体パターン上に実装された受光素子と；前記受光素子と前記第4導体パターンを接続する第2ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第1光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第2光導波路と；前記第1及び第2光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第3光導波路と；前記受光素子、該受光素子と前記第3光導波路の光結合部及び前記第3及び第4導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【0018】

【発明の実施の形態】以下、図面を参照して本発明の数多くの実施形態について説明する。各実施形態の説明において、実質的に同一構成部分については同一符号を付して説明する。

【0019】図1を参照すると、本発明第1実施形態の光送受信デバイス2Aの断面図が示されている。Si基板等の基板4上には絶縁層6が形成されている。基板4がシリコンから形成される場合には、絶縁層6はSiO<sub>2</sub>から形成される。

【0020】絶縁層6の左側には一対の導体パターン8、10が形成されており、右側には他の一対の導体パターン16、18が形成されている。導体パターン8上にはレーザダイオード12が実装されており、レーザダイオード12と導体パターン10とは金ワイヤ14でボンディング接続されている。導体パターン16上にはフォトダイオード20が実装されており、フォトダイオード20と導体パターン18とは金ワイヤ22でボンディ

ング接続されている。

【0021】絶縁層6中には2本の光導波路コア24、26が埋設されている。光導波路コア24の一端はレーザダイオード12に光結合するように配置されており、他端は図示しない出力ポートに接続されている。光導波路コア26の一端はフォトダイオード20に光結合するように配置されており、他端は図示しない入力ポートに接続されている。

【0022】絶縁層6上には電極28が形成されており、電極28は接地されている。電極28上には銀シリコン等の導電性樹脂30が塗布されている。電極28を接地する代わりに、例えば3V、5V等の電位一定な電源に接続するようにしてもよい。

【0023】本実施形態によれば、レーザダイオード12とフォトダイオード20の間に導電性樹脂30が設けられているので、レーザダイオード12とフォトダイオード20との間の漏話を低減することができる。

【0024】図2を参照すると、本発明第2実施形態の光送受信デバイス2Bの断面図が示されている。本実施形態ではレーザダイオード12の周囲にシリコン樹脂等の透明絶縁性樹脂32が塗布されている。

【0025】透明絶縁性樹脂32はレーザダイオード12と光導波路コア24との光結合部、ワイヤ14及び導体パターン8、10の一部を覆っている。この透明絶縁性樹脂32は光導波路コア24への光路を確保すると共に、後で適用される導電性樹脂による導体パターン8、10の短絡を防止する役割を有している。

【0026】透明絶縁性樹脂32上には銀シリコン等の導電性樹脂34が塗布されている。導電性樹脂34は接地された電極36に接続されている。電極36を接地する代わりに、電位一定の電源に接続するようにしてもよい。

【0027】本実施形態によれば、レーザダイオード12が透明絶縁性樹脂32及び導電性樹脂34で覆われているため、レーザダイオード12からフォトダイオード20等の他の回路部品への漏話を低減することができる。

【0028】図3を参照すると、本発明第3実施形態の光送受信デバイス2Cの断面図が示されている。本実施形態では、フォトダイオード20の周囲にシリコン樹脂等の透明絶縁性樹脂38が塗布されている。透明絶縁性樹脂38はフォトダイオード20と光導波路コア26との光結合部、ワイヤ22及び導体パターン16、18の一部を覆っている。

【0029】透明絶縁性樹脂38上には銀シリコン等の導電性樹脂40が塗布されている。導電性樹脂40は接地された電極42に接続されている。電極42を接地する代わりに、電位一定の電源に接続するようにしてもよい。

【0030】透明絶縁性樹脂38は導波路コア26から



フォトダイオード20への光路を確保すると共に、塗布された導電性樹脂40による導体パターン16、18の短絡を防止する役割を有している。

【0031】本実施形態によれば、レーザダイオード12からフォトダイオード20への漏話を有効に遮断できるばかりでなく、外部に設けられた駆動用ICなどの外来雑音をも遮断する効果を期待できる。

【0032】図4を参照すると、本発明第4実施形態の光送受信デバイス2Dの断面図が示されている。図5は第4実施形態の平面図を示している。本実施形態では、レーザダイオード12の周囲がシリコン樹脂等の透明絶縁性樹脂32で覆われていると共に、透明絶縁性樹脂32が銀シリコン等の導電性樹脂34で覆われている。

【0033】また、フォトダイオード20の周囲もシリコン樹脂等の透明絶縁性樹脂38で覆われており、透明絶縁性樹脂38は銀シリコン等の導電性樹脂40で覆われている。

【0034】更に、本実施形態では、Si基板4に溝46が形成されており、この溝46中に波長選択フィルタ48が挿入され、透明接着剤50で固定されている。図5に示されるように、Si基板4上にはレーザダイオード12と波長選択フィルタ48とを光結合する第1光導波路コア54と、フォトダイオード20と波長選択フィルタ48とを光結合する第2光導波路コア56が形成されている。

【0035】Si基板4上には更に、第1及び第2光導波路コア54、56を伝搬する光を光結合するように、波長選択フィルタ48と光入出力ポート59との間に第3光導波路コア58が形成されている。

【0036】波長選択フィルタ48の周囲は銀シリコン等の導電性樹脂52で覆われている。Si基板4上には基板コンタクト電極64、66、68、70が直接形成されている。

【0037】Si基板4の裏面には裏面電極72が形成されている。裏面電極72は接地されている。裏面電極72を接地する代わりに、電位一定の電源に接続するようにしてもよい。

【0038】Si基板4は導電性であるから、導電性樹脂34は基板コンタクト電極64、Si基板4、裏面電極72を介して接地される。同様に、導電性樹脂40は基板コンタクト電極66、Si基板4及び裏面電極72を介して接地される。更に、導電性樹脂52は基板コンタクト電極68、70、Si基板4及び裏面電極72を介して接地される。

【0039】本実施形態によれば、レーザダイオード12が透明絶縁性樹脂32を介して導電性樹脂34で覆われ、フォトダイオード20が透明絶縁性樹脂38を介して導電性樹脂40で覆われている。更に、レーザダイオード12とフォトダイオード20の間に導電性樹脂52

が設けられている。

【0040】よって、レーザダイオード12とフォトダイオード20との間の漏話を有効に遮断乃至低減できると共に、外部に設けられた駆動用IC等の外来雑音をも有効に遮断又は低減することができる。その結果、小型で非同期動作可能な光送受信デバイスの実現が可能である。

【0041】以下、図面を参照して第4実施形態の光送受信デバイス2Dの製造プロセスを説明する。まず、図6(A)に示すように、Si(100)基板74上に約1 $\mu$ m程度の厚さのSiO<sub>2</sub>膜76を例えば熱酸化等により形成する。

【0042】次いで、フォトリソグラフィでパターンニングして、テラス78を形成する領域以外のSiO<sub>2</sub>膜(酸化膜)76を除去する。KOH溶液に浸し、SiO<sub>2</sub>膜76を除去した領域をエッチングする。このエッチングの深さは導波路のアンダークラッドの厚さ程度、即ち約20 $\mu$ m程度とする。

【0043】次いで、図6(B)に示すように、火炎堆積法等によりエッチングした深さだけ第1のアンダークラッド80となるSiO<sub>2</sub>を基板全面に堆積する。次いで、図6(C)に示すように、テラス78の上面が露出するまで研磨し、平坦化する。

【0044】図7(D)に示すように、第2のアンダークラッド82となるSiO<sub>2</sub>を下式で求められる厚さだけ基板74の全面に堆積する。

堆積厚さ=(導体パターン厚)+(ハンダ厚)+(レーザダイオードの活性層高さ)

この堆積厚さは約20 $\mu$ m程度である。次いで、ゲルマニウム(Ge)等の屈折率を増加させる不純物をドーパしたコア層84を堆積し、導波路部以外の不要な領域をフォトリソグラフィによりパターンニングして除去して、導波路コアを形成する。次いで、基板全面にアンダークラッド80、82と同程度の厚さSiO<sub>2</sub>を堆積し、オーバークラッド86を形成する。

【0045】次いで、図7(E)に示すように、光子搭載部及び導体パターン形成部を含む領域をリアクティブ・イオン・エッチング(RIE)でエッチングし、導波路端面90、92を形成する。エッチングする深さはテラス78の上面が丁度露出するまでとする。

【0046】同様に、RIEでエッチングして、穴91、93、95、97を形成し、これらの穴中にSi基板74と導通をとる基板コンタクト電極64、66、68、70を形成する。88はレジストである。

【0047】次いで、図8及び図9に示すように、熱酸化によりテラス78上に約0.5 $\mu$ m程度の薄いSiO<sub>2</sub>絶縁膜6を形成する。更に、ダイシングソーを使用して導波路コア54、56、58が合流する点を横断する溝94を形成する。

【0048】次いで、基板全面にTi、Ni、Auを順

次蒸着し、更にレジストを塗布する。導体パターン6, 8, 16, 18の部分を残してフォトリソグラフィ技術によりレジストを除去し、エッチングをする。

【0049】エッチングはRIEで行ってもよいし、基板をエッチャントに浸してもよい。Ti及びNiに対しては硝酸系のエッチャントを使用し、Auには金エッチャントを使用する。代替案として、リフトオフ法により導体パターン6, 8, 16, 18も形成することが可能である。同様に、基板74の裏面に裏面電極72を形成する。

【0050】次いで、基板上面全体に例えばポリイミド樹脂をスピナーで塗布し、更にレジストを塗布する。レジストをフォトリソグラフィ技術によりパターンニングして、更に溶剤に浸漬し、少なくとも光素子搭載部、ワイヤボンディング用のパッド部、導波路端面が露出するようにポリイミド樹脂を除去する。

【0051】これにより、図10に示すように導体パターンニング8, 10の一部がポリイミド絶縁層96で覆われ、導体パターンニング16, 18の一部がポリイミド絶縁層98で覆われる。次いで、ダイシングソーによりSi基板74を各PLCプラットフォームに切断する。

【0052】次いで、図11に示すようにレーザダイオード12及びフォトダイオード20を所定の位置にボンディングにより実装する。このボンディングは光素子12, 20側にハンダバンプを形成して行ってもよいし、PLCプラットフォーム側にハンダバンプ設けるようにしてもよい。

【0053】レーザダイオード12及びフォトダイオード20の実装後、レーザダイオード12と導体パターン10とを金ワイヤ14でボンディング接続し、フォトダイオード20と導体パターン18とを金ワイヤ22でボンディング接続する。更に、波長選択フィルタ48を溝94中に挿入し、透明な接着剤50で波長選択フィルタ48をPLCプラットフォーム(基板)4に固定する。

【0054】次いで、図4及び図5に示すように、レーザダイオード12及びフォトダイオード20の周囲にシリコン樹脂等の透明絶縁性樹脂32, 38をポッティングし、キュアする。

【0055】必要によっては、レーザダイオード12及びフォトダイオード20の周囲にシリカ等のフィラを混入した粘度の高いシリコン樹脂をダム状に塗布して、

透明なシリコン樹脂の流れ止めとしてもよい。

【0056】更に、透明絶縁性樹脂32, 38の外側及び波長選択フィルタ48の周囲を銀シリコン樹脂等の導電性樹脂34, 40, 52で覆う。このとき、導電性樹脂34, 40, 52が基板コンタクト電極64, 66, 68及び70に接触するようにする。最後に導電性樹脂34, 40, 52をキュアする。

【0057】このようにして形成した第4実施形態の光送受信デバイス2Dが図4及び図5に示されている。更に、特に図示しないが光送受信デバイス2Dをプラスチックモールド等によりパッケージングする。

【0058】

【発明の効果】以上説明したように、本発明によれば、同一基板上にハイブリッド実装された発光素子と受光素子間の漏話を低減することのできる光送受信デバイスを提供することができる。更に、コンパクト且つ非同期動作が可能な光送受信デバイスの提供が可能となり、光加入者系の普及に寄与することができる。

【図面の簡単な説明】

【図1】本発明第1実施形態の断面図である。

【図2】本発明第2実施形態の断面図である。

【図3】本発明第3実施形態の断面図である。

【図4】本発明第4実施形態の断面図である。

【図5】第4実施形態の平面図である。

【図6】製造プロセスを示す図である。

【図7】製造プロセスを示す図である。

【図8】製造プロセスを示す図である。

【図9】製造プロセスを示す図である。

【図10】製造プロセスを示す図である。

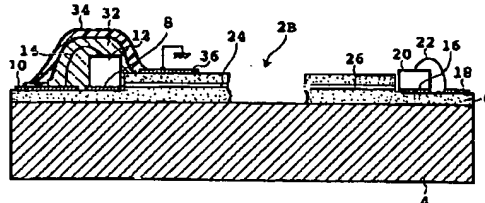
【図11】製造プロセスを示す図である。

【符号の説明】

- 4 基板
- 8, 10, 16, 18 導体パターン
- 12 発光素子
- 20 受光素子
- 24, 26 光導波路
- 28, 36, 42 電極
- 30, 34, 40, 52 導電性樹脂
- 32, 38 透明絶縁性樹脂
- 64, 66, 68, 70 基板コンタクト電極

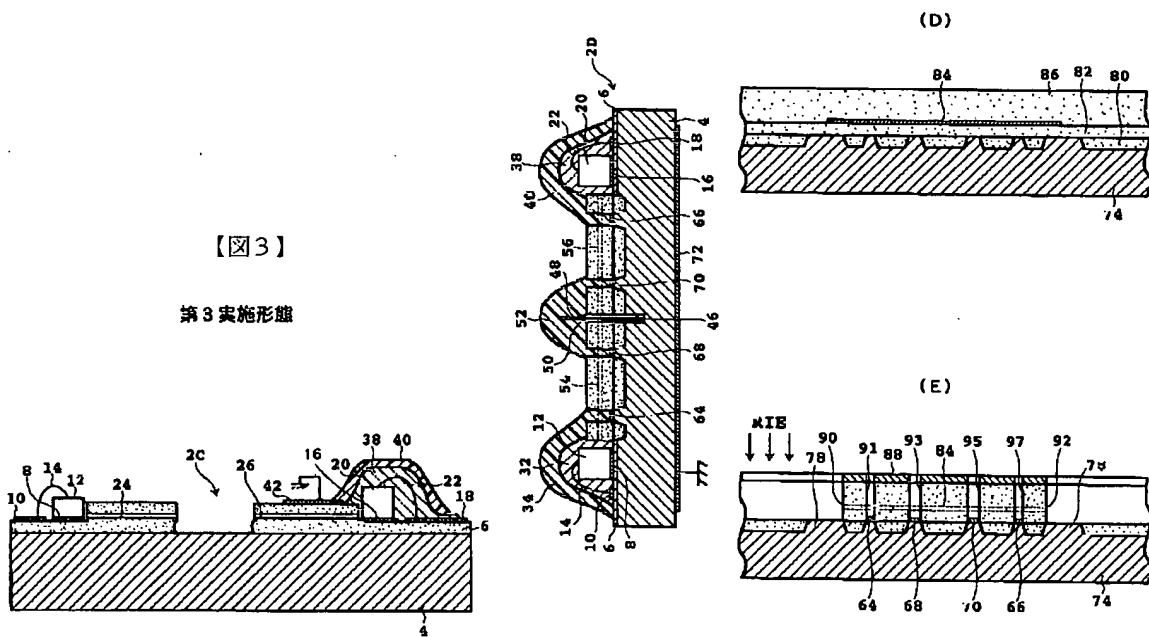
【図2】

## 第2 實施形態

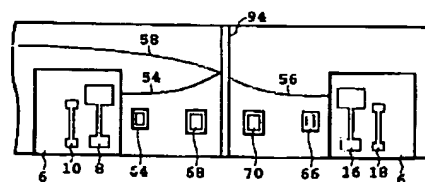


【図7】

### 製造プロセス図

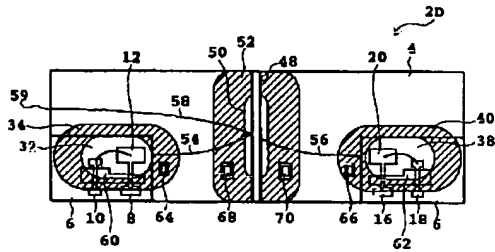


### 製造プロセス図



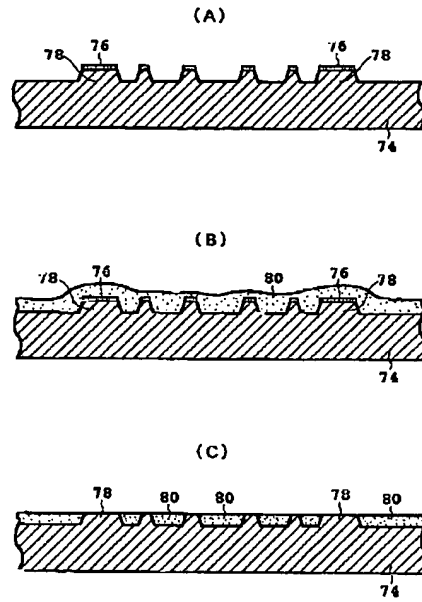
【図5】

第4実施形態平面図



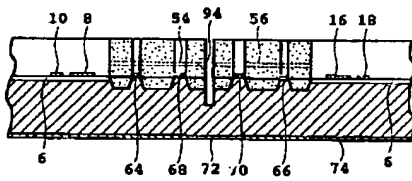
【図6】

製造プロセス図



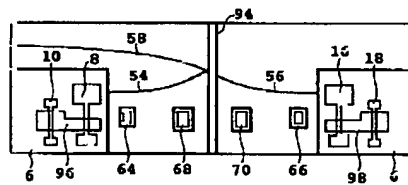
【図9】

製造プロセス図



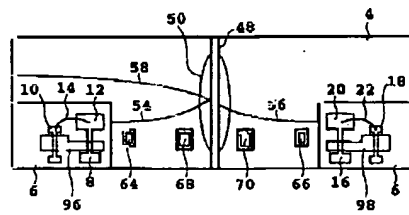
【図10】

製造プロセス図



【図11】

製造プロセス図



フロントページの続き

(51)Int. Cl.<sup>6</sup>  
H04B 10/18

識別記号

F I